

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR24FA083

COCKPIT VOICE RECORDER

Group Chair's Factual Report

April 22, 2025

WARNING

The reader of this report is cautioned that the summary and transcript of a cockpit voice recorder audio recording is not a precise science but is the best product possible from a National Transportation Safety Board group investigative effort. The summary and transcript or parts thereof, if taken out of context, could be misleading. The summary and transcript should be viewed as an accident investigation tool to be used in conjunction with other evidence gathered during the investigation. Conclusions or interpretations should not be made using the summary and transcript as the sole source of information.

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A. ACCIDENT

Location: Westwater, Utah
Date: February 7, 2024
Time: 1048 Local
Airplane: HAWKER BEECHCRAFT CORP HAWKER 900XP, Clay Lacy Aviation, Inc.,
N900VA

B. COCKPIT VOICE RECORDER GROUP

Group Chair	Joseph Gregor Recorder Specialist National Transportation Safety Board (NTSB)
Group Member	Patrick Lusch Senior Air & Space Accident Investigator Federal Aviation Administration / AVP-110
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C. FEDERAL CARRIAGE REQUIREMENTS

The event aircraft, N900VA, was operating as Title 14 *Code of Federal Regulations* (CFR) Part 91: General aviation. The aircraft was manufactured in 2007 and was operating such that it was required to be equipped with a cockpit voice recorder (CVR) that records a minimum of the last 30 minutes of aircraft operation.

D. DETAILS OF THE INVESTIGATION

The NTSB Vehicle Recorder Division received the following CVR:

Recorder Manufacturer/Model:	Universal CVR-120
Part Number:	unknown
Recorder Serial Number:	unknown

1.0 Recorder Description

The Universal CVR-120 is a solid state CVR that records 120 minutes of audio digitally. Specifically, it contains a 2-channel recording of the last 120 minutes of operation and separately contains a 4-channel recording of the last 30 minutes of operation. The 120-minute portion of the recording is comprised of one channel that combines three audio panels sources – captain (CAPT), first officer (FO), and Observer – and a second channel that contains the cockpit area microphone (CAM) source. The 30-minute portion of the recording contains 4 channels of audio information: one channel for each flight crew, one channel for the CAM, and one channel for a cockpit observer.

1.1 Recorder Damage

Upon arrival at the laboratory, it was evident that the exterior of the CVR crash case had sustained extreme heat exposure as shown in figure 1. The remainder of the CVR, if it was found, was not shipped to the recorder lab. The crash survivable memory module showed extreme signs of heat-induced structural damage including warping, delamination, and carbonization of the printed circuit board (PCB) and flex cable material, as well as solder reflow across the entire module (see figures 2 through 7).



Figure 1. Heat damaged crash case of the CVR (view of bottom).



Figure 2. View of crash case opened to reveal heat insulation material and ribbon cable.

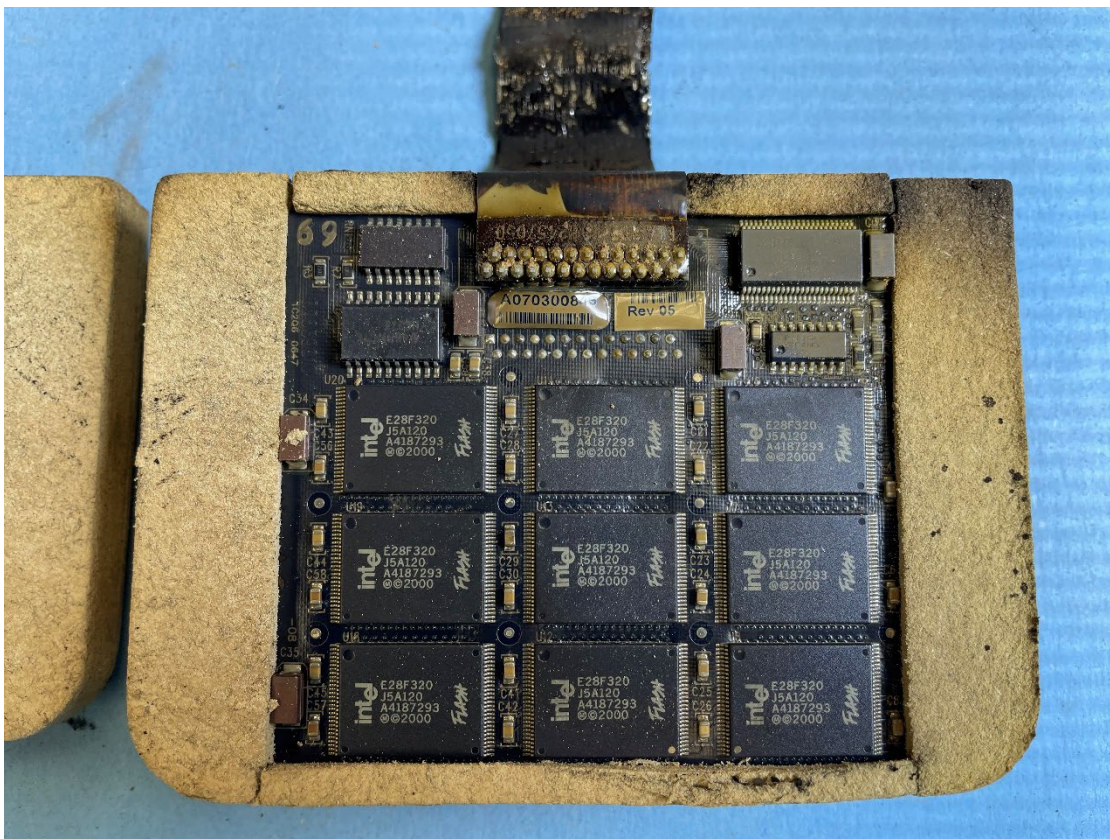


Figure 3. Memory module (within heat insulation material) showing signs of extreme heat damage.

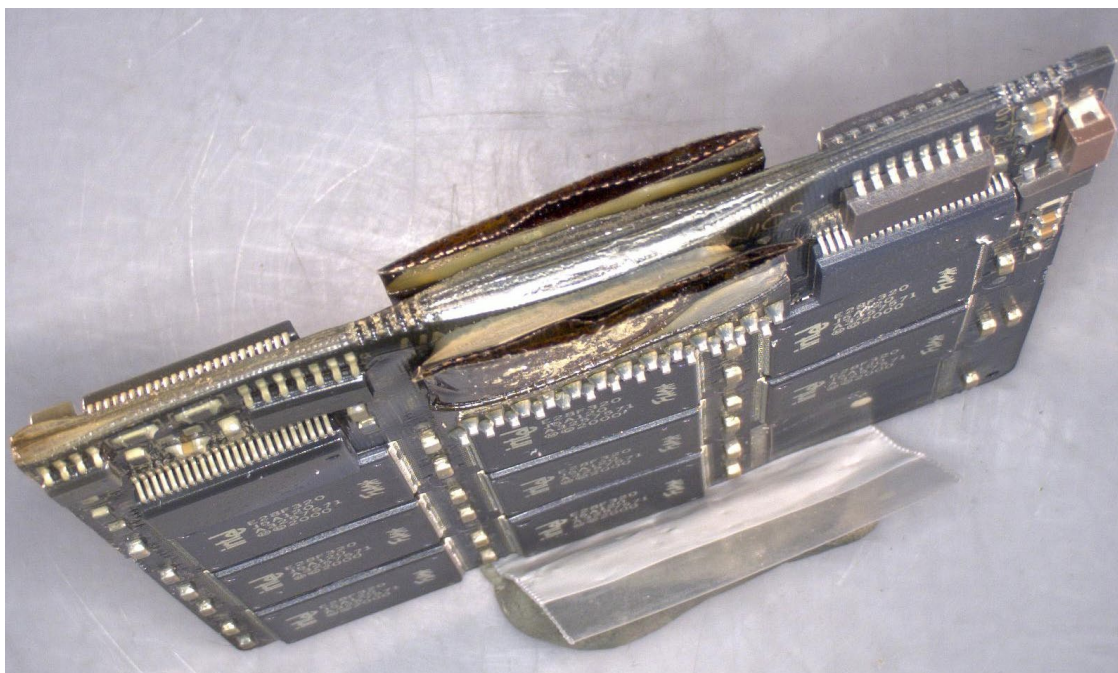


Figure 4. Memory module showing severe delamination and warping at the flex cable entry.

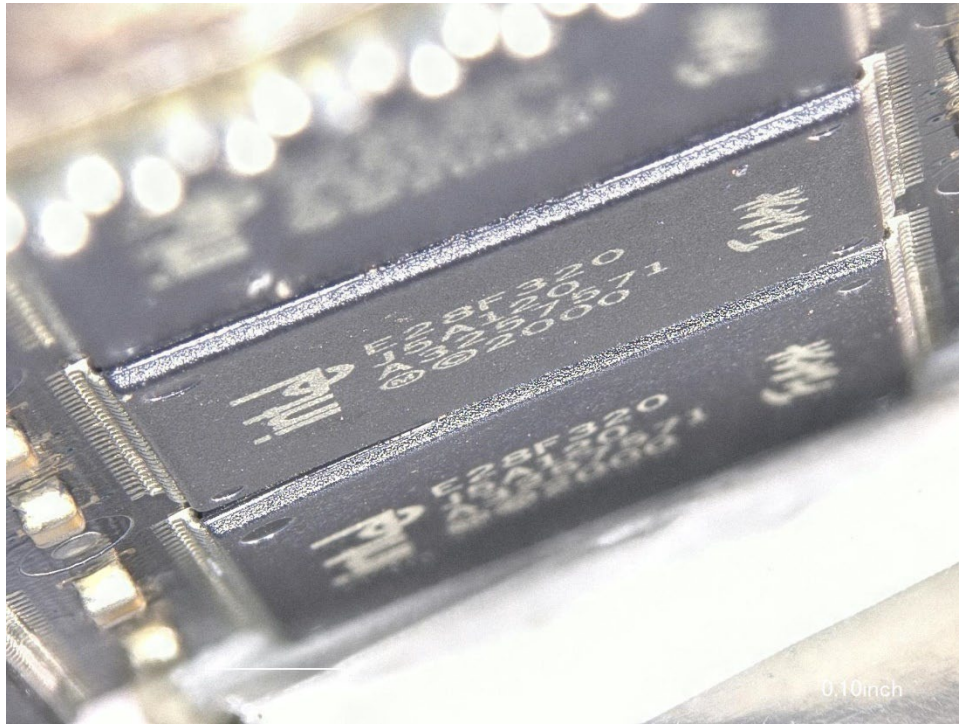


Figure 5. Memory module signs of delamination and warping.

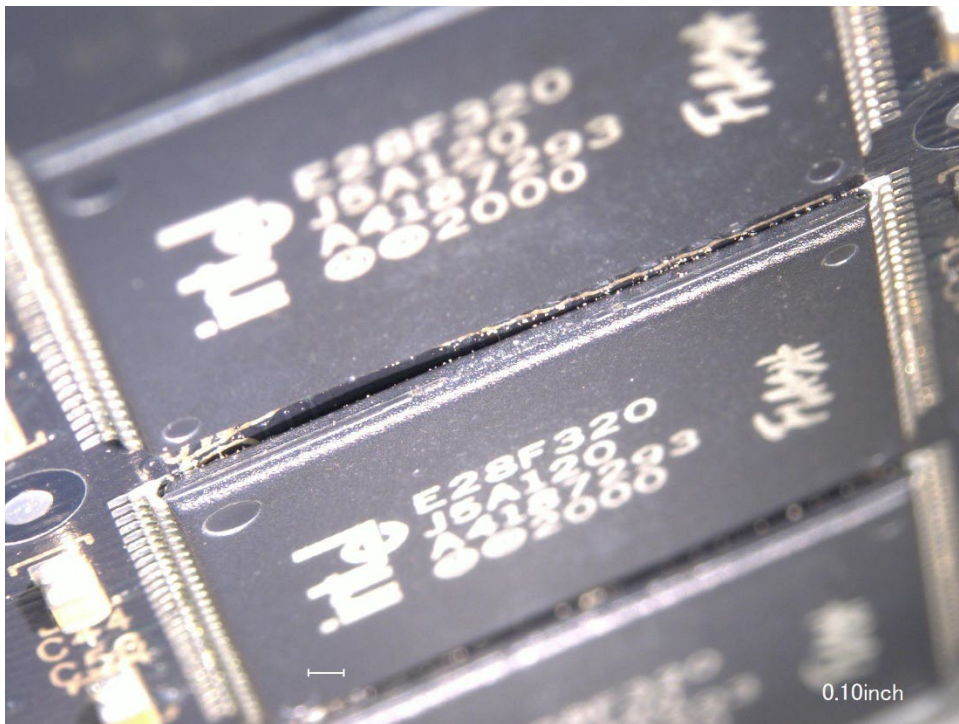


Figure 6. Memory module signs of delamination and warping.

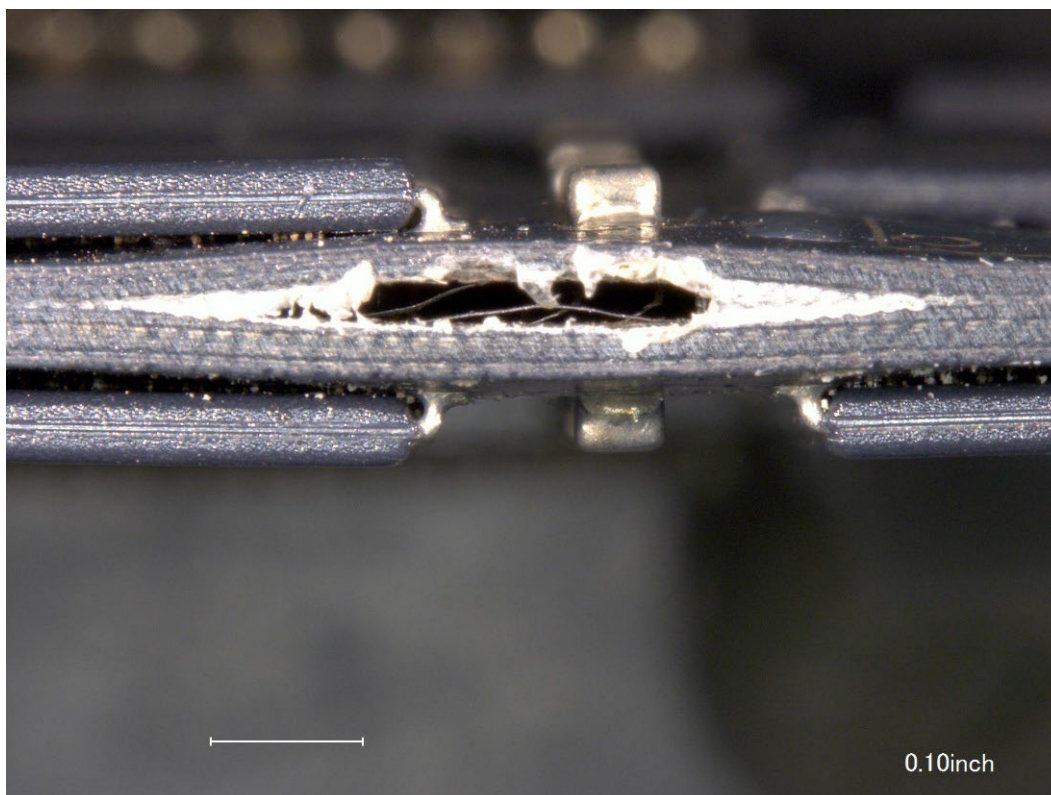


Figure 7. Memory module signs of delamination and warping at the opposite end from the flex cable.

The memory module for this CVR contained 17 non-volatile memory (NVM) integrated circuit FLASH memory chips.¹ All appeared to be physically intact. The module was coated with an unusually thick layer of Parylene² that had undergone transformation due to extreme heat exposure. This conformal coating prevented the mounted electronic parts from floating off the printed circuit board (PCB) once the temperature exceeded solder-melt. The baked-on Parylene had to be removed from over, under, and around each FLASH chip before it could be safely de-soldered and removed from the PCB. Due to Parylene's extreme resistance to chemical attack, removal was done mechanically by-hand under microscopy. The removal process was complicated by the presumed fragility of the accident FLASH memory chips.

Since the FLASH chips from the accident board had already been exposed to extreme heat, all solder work was done by hand under magnification to avoid reheating the entire chip. First, the accessible Parylene was removed from the

¹ The memory devices used on the accident module were Intel E28F320J5A120 © 2000 NOR-type FLASH memory.

² A heat and chemical resistant polymer conformal coating applied to electronic subassemblies to protect them from corrosion under harsh environmental conditions. This coating is applied in a gaseous-phase deposition process that produces a coating on every surface accessible to free floating molecules.

accident board mechanically using surgical scalpels and various silicon carbide and tungsten pins custom shaped on a diamond wheel. The solder holding the pins of the FLASH chips to the PCB was then removed using flux, solder-wick, and a handheld soldering iron (to minimize heat transfer to the silicon dies within the FLASH devices). The pins were individually ensured to be mechanically free from their solder pads using pin vices under microscopy and any giving resistance to shifting were desoldered again. This process was repeated iteratively until all the pins were assured free from any solder bond to the PCB.

However, after desoldering, the chips remained bonded to the board by the Parylene coating not accessible to mechanical removal without risk of catastrophic pin damage.³ Directed air heating was used to soften the remaining Parylene so that the end of each chip could be careful raised in stages under microscopy to ensure that no pins were being compromised during the process and minimal bending and twisting forces applied to the thin, flat body of the FLASH chip itself. Once raised sufficiently, the remaining Parylene bonding the chips to the board was cut using a heated surgical scalpel and the process carefully repeated for the opposite end of the chip (see figures 8 through 12).

³ A Parylene coating was present on all surfaces including the entire 360 surface of each pin on the FLASH memory chips. The Parylene effectively formed a glue between the ends of each chip behind and under the pins and the surface of the PCB it was mounted on.



Figure 8. FLASH memory device mounted on accident memory module PCB before Parylene removal.

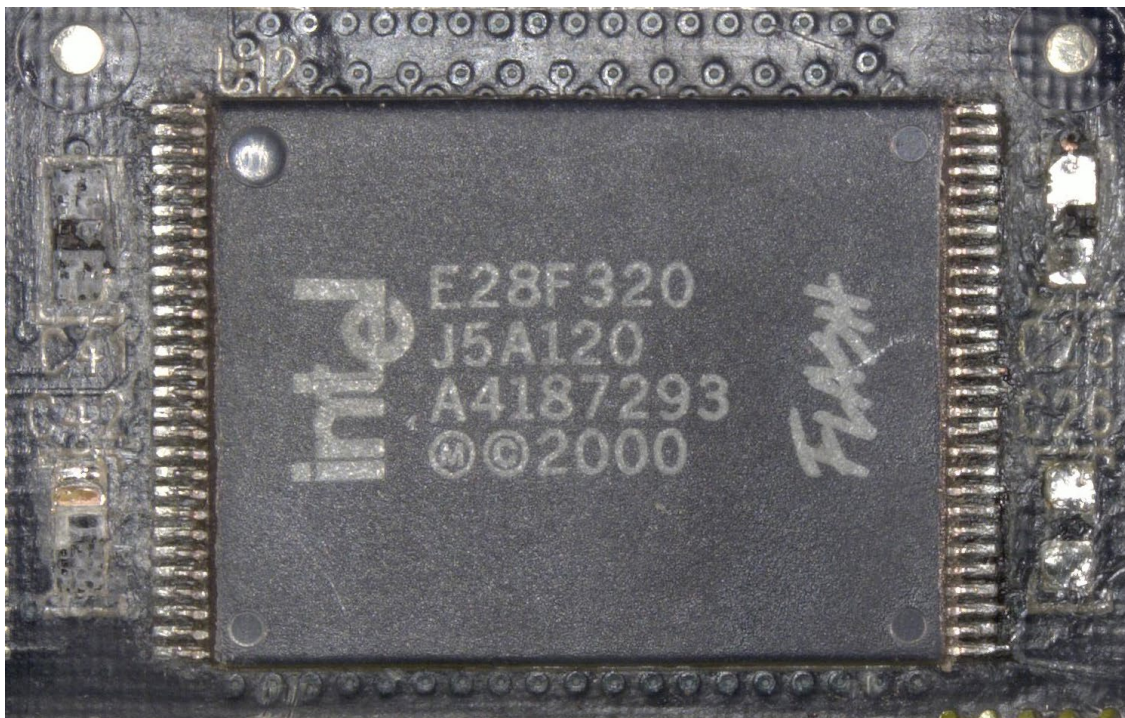


Figure 9. FLASH memory device after initial Parylene removal.

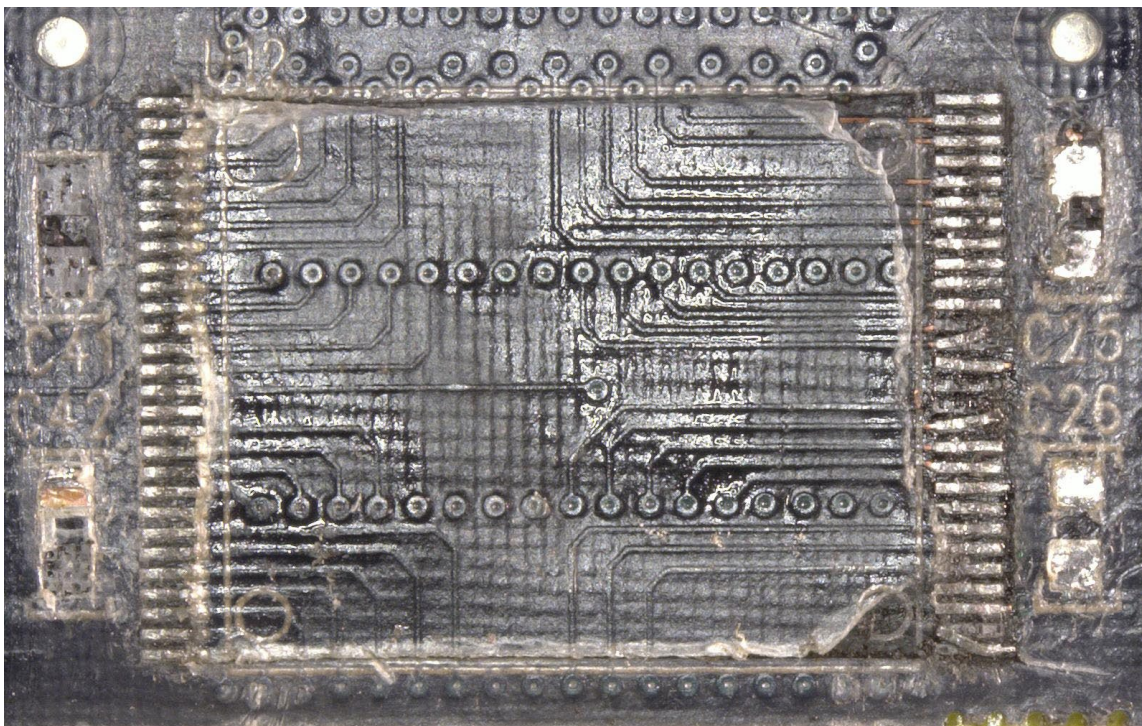


Figure 10. PCB after removal of the FLASH memory device.



Figure 11. FLASH memory device after removal from the PCB (top view).



Figure 12. FLASH memory device after removal from the PCB (bottom view).

Due to what appeared to be a heat-induced chemical interaction between the original solder and the metallization of chip leads, there was metal loss and weakening of many pins on various chips. To prevent loss, some pins required careful repair via partial removal of the black packaging material to expose the internal lead frame. The area was then silver-soldered to provide a reliable electrical connection and mitigate against mechanical breakage (see figures 13 and 14). This was also done by-hand under microscopy using specialized tools.

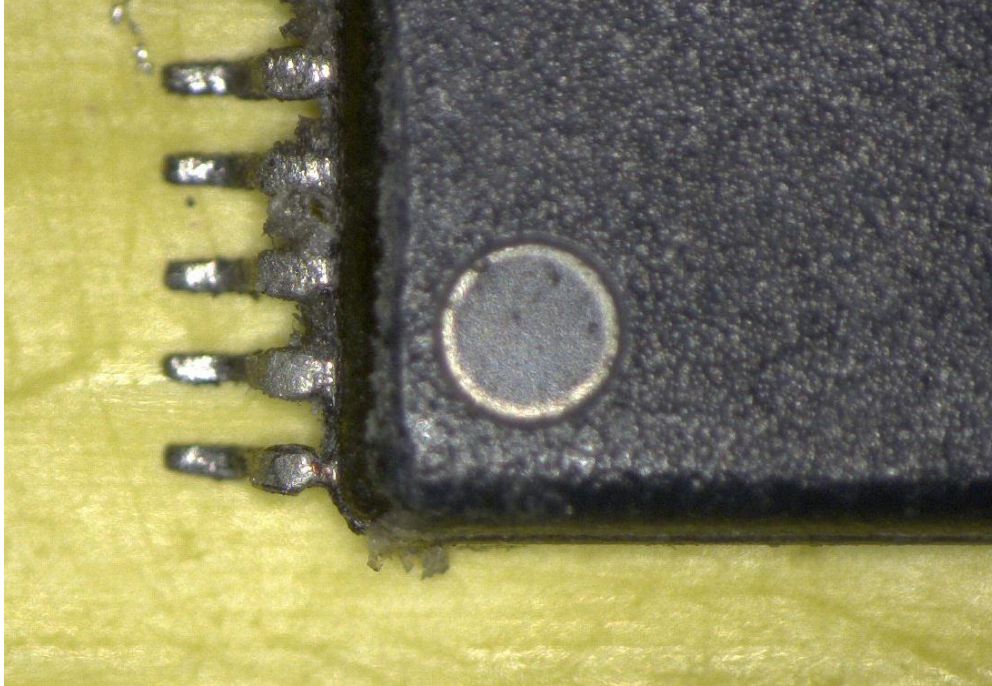


Figure 13. FLASH memory device showing severe metal loss at root of bottom pin.

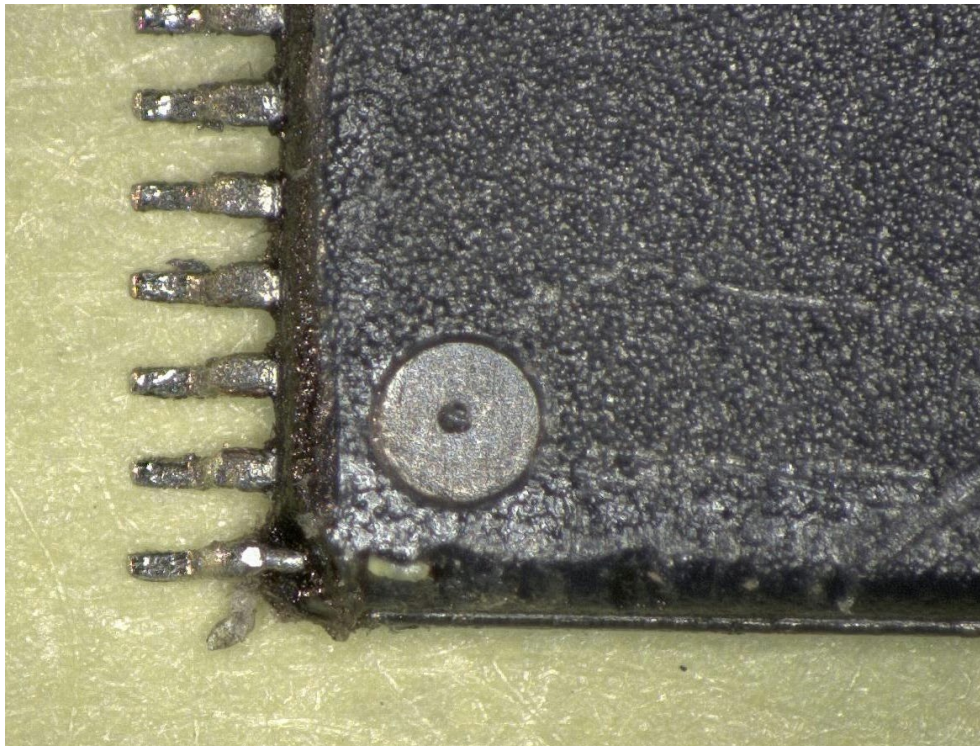


Figure 14. FLASH memory device showing silver-solder repair at root of bottom pin.

Once a chip was removed from the PCB, all remaining solder and Parylene was carefully cleaned from behind and under each pin so that it could be installed in the socket of a FLASH memory programmer for read-out. A temporary jig was constructed so that this could be done under microscopy using the specialized tools to reduce the risk of damaging or breaking off pins due to their fragility (see figures 15 - 18).

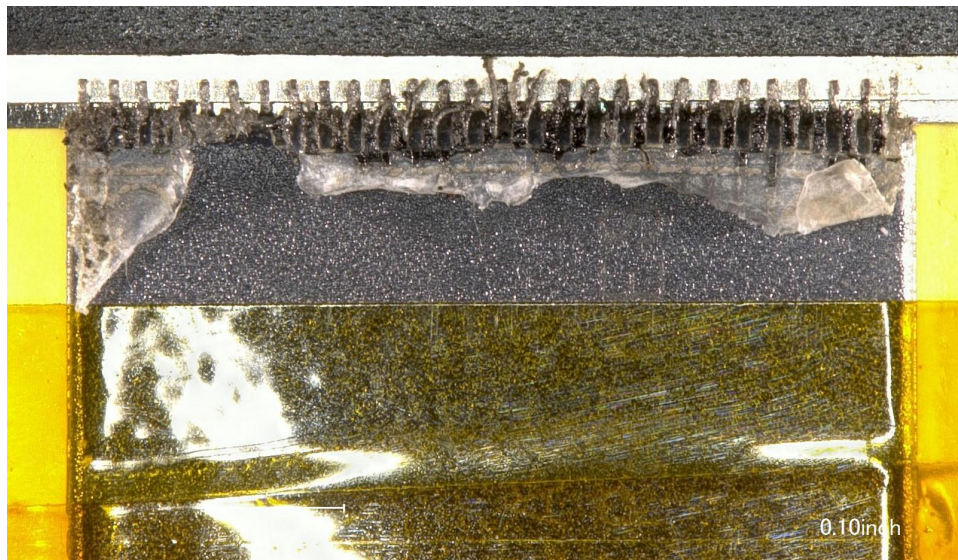


Figure 15. FLASH memory device showing underpin contamination before cleaning.

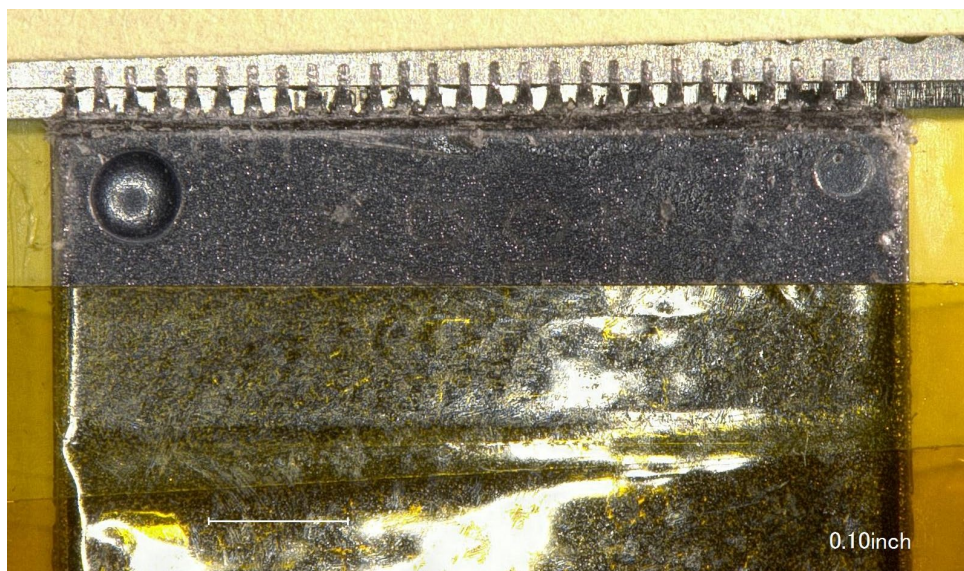


Figure 16. FLASH memory device showing underpin contamination after initial cleaning.



Figure 17. Top view of FLASH memory device after cleaning.

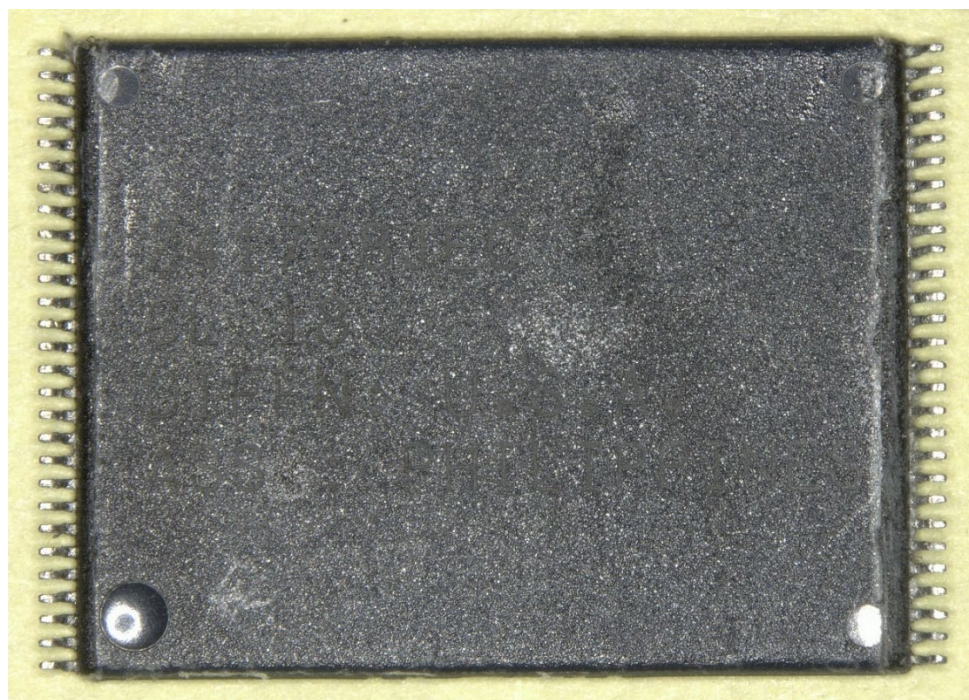


Figure 18. Bottom view of FLASH memory device after cleaning.

Four FLASH chips were initially selected for removal and readout using a commercial FLASH memory programmer to determine if they still retained uncorrupted data.⁴ There appeared to be structured data at least partially intact on these chips, so a plan was made to move forward with a recovery strategy.

Universal was contacted and verified that no manufacturer method existed to recover audio data directly from the raw data stored on the FLASH memory chips. An in-house NTSB effort to create a software reconstruction capability using raw data read from the FLASH memory chips was explored. Simultaneously, a hardware recovery strategy was pursued by obtaining the closest matching surrogate memory module available from the manufacturer - Universal Avionics. This was a 30-minute module using E28F320J5-120 ©1997 FLASH memory devices - an older version of the chips used in the accident memory module.⁵ Universal indicated that the PCB itself was identical for both versions of this module and provided modification instructions to convert the 30-minute module to the 2-hour configuration. Blank new-old-stock (NOS) FLASH memory devices were obtained to program with images of the data recovered from the accident FLASH chips - which were too fragile to risk attempting to re-solder onto a new PCB. The data image read out from each 30-minute E28F320J5A-120 chip removed from the accident memory module was loaded onto a corresponding NOS E28F320J5-120 chip to make 1:1 copies of each chip.⁶

The first four FLASH chips removed from the accident module - U18, U19, U21, and U22 - contained data corresponding to the 2-hour Combined HOT microphone channel. The surrogate module was modified per instructions from Universal. The Parylene coating was then manually removed from the four vacant positions these chips would occupy in the 2-hour configuration, and the NOS⁷ copy devices were soldered onto the surrogate board. The surrogate module was then connected to an NTSB 'Golden Chassis' surrogate recorder for download using the normal procedure.

All attempts to read the surrogate module in this configuration failed; with the NTSB surrogate unable to complete the initial boot-up process. All efforts with assistance from the manufacturer to make this configuration work also failed. The surrogate memory module was modified back to its original 30-minute configuration,

⁴ The published upper operational temperature range for this device is 85 °C (185 °F). The published upper storage temperature for this device is 125 °C (257 °F). The upper operating temperature limit for data retention is generally considered to be in the neighborhood of 150 °C (300 °F) for anything but short exposures.

⁵ The accident module was of a newer vintage than the surrogate module and used a newer version of FLASH memory chip - E28F320J5A-120 ©2000 -to store the data than the surrogate module.

⁶ Using the XELTEK SP6100 programmer, each accident chip was read out using the E28F320J5A-120 algorithm (corresponding to the accident chip device number) and the resulting image written to a copy chip using the E28F320J5-120 algorithm (corresponding to the copy chip device number).

⁷ New old stock.

and the NTSB golden chassis once again booted-up normally and a successful playback of the 30-minute portion of the surrogate module was obtained.⁸

It was determined that the FLASH chips corresponding to the 30-minute portion of the recording would need to be removed from *both* modules, the accident chips imaged and copied, and the copy chips mounted onto the surrogate module. This corresponded to nine additional FLASH memory devices: U6, U7, U8, U9, U10, U11, U12, U13, and U14.

All of these chips were successfully removed by-hand from the accident module and imaged. All except for U14 contained what appeared to be structured data. U14 read out as all 'FF' (blank) with an unidentified manufacturer ID error message. This was consistent with data loss due to extreme heat exposure. It was noted that this chip was positioned closest to the flex cable connector leading from the PCB to the outside of the crash case. U14 contained approximately 2/3 of the recorded data for the second in command's HOT mic channel, which was not recovered.

Next, six of the 30-minute FLASH memory chips U6, U7, U8, U9, U10, and U11 were removed from the Parylene coated surrogate memory module by-hand using the same procedure as for removal of the accident module chips. Only in this case priority was to maintain the integrity of the pads, landings, and electrical traces on the surrogate PCB because no damage to the surrogate board could be tolerated.⁹ Once completed, the surrogate board was carefully cleaned and prepped for parts placement, and the corresponding copy chips soldered onto the surrogate board in the same locations as their originals occupied on the accident module.

The surrogate module was connected to an NTSB 'Golden Chassis' surrogate recorder for download using the normal procedure. The NTSB golden chassis booted-up normally and a successful playback of the 30-minute portion of the data was obtained. This audio was digitized using standard A/D software yielding the results summarized in the next section (see table 1).

⁸ At this point, the 30-minute portion of the surrogate memory module provided by Universal was devoid of audio data. So these channels were blank.

⁹ Copies of U12 and U13, corresponding to the Other (Jump Seat) position, were not attached to the surrogate PCB to reduce the risk of damaging the surrogate memory module and rendering it inoperable. A copy of U14 was not attached to the surrogate memory module because the accident FLASH device was heat-damaged and contained no valid data.

1.2 Audio Recording Description

Recovered audio quality for each channel is indicated in Table 1.¹⁰ Channel number one did not contain any audio information (nor was it required by federal regulations).

Table 1. Audio Quality

Channel Number	Content/Source	Quality	Duration
1	Other	N/A	
2	SIC ¹¹	Excellent	<<10.6 min>>
3	PIC ¹²	Excellent	<<30 min>>
4	CAM ¹³	Poor - Fair	<<30 min>>

1.3 Timing and Correlation

Timing on the transcript was established by correlating the CVR events to common events on the flight data recorder (FDR). Specifically, 21 radio transmissions that the aircraft made were correlated to the radio transmit microphone key parameter from the FDR and a linear interpolation made to best-fit the CVR events. Reference to local time (MST) was obtained from GPS-time based data recorded on the FDR. Error bars for the correlation are ± 1 second. Timing in the transcript is expressed with 0.1 second precision.

1.4 Description of Audio Events

The recording began at 1015:39 MST and the transcript began at 1016:37 MST with sounds and discussion consistent with initial checks and setting up for the departure. From 1016:37 MST to 1031:43 MST, Sounds and discussion consistent with the performance of the before start checklist, the start checklist, the after start checklist, and the before takeoff checklist were recorded. The takeoff briefing was given at about 1034:06 MST. At 1036:19 MST the flight was cleared for takeoff by the tower. At 1042:25 MST the flight requested from Denver center a block altitude from FL180 to FL200. At 1043:09 MST the SIC stated that the climb checklist was complete. At 1043:53 the CAM recorded sounds consistent with decreasing engine noise. At 1045:00 the CAM recorded a sound consistent with the autopilot disconnect warning. At 1045:51 the CAM recorded sounds consistent with the gear warning horn, followed 42 seconds later by sounds consistent with the stick shaker.

¹⁰ Appendix A comprises the CVR Quality Rating Scale.

¹¹ Second in command.

¹² Pilot in command.

¹³ Cockpit Area Microphone.

At 1046:34, the SIC stated, "one nineteen." Approximately 2.8 seconds later the PIC exclaimed, and the CAM recorded sounds of the stick shaker, rattling, increased engine noise, and multiple EGPWS warnings. At 1047:39 the CAM recorded an EGPWS audible "terrain, terrain, pull up, pull up" warning. The recording ended shortly thereafter at 1047:44 MST.

Submitted by:

Joseph Gregor
Recorder Specialist

APPENDIX A. CVR QUALITY RATING SCALE

The levels of recording quality are characterized by the following traits of the cockpit voice recorder information:

- Excellent Quality** Virtually all crew conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.
- Good Quality** Most of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate several words or phrases that were not intelligible. Any loss in the transcript can be attributed to minor technical deficiencies or momentary dropouts in the recording system or to a large number of simultaneous cockpit/radio transmissions that obscure each other.
- Fair Quality** The majority of the crew conversations were intelligible. The transcript that was developed may indicate passages where conversations were unintelligible or fragmented. This type of recording is usually caused by cockpit noise that obscures portions of the voice signals or by a minor electrical or mechanical failure of the CVR system that distorts or obscures the audio information.
- Poor Quality** Extraordinary means had to be used to make some of the crew conversations intelligible. The transcript that was developed may indicate fragmented phrases and conversations and may indicate extensive passages where conversations were missing or unintelligible. This type of recording is usually caused by a combination of a high cockpit noise level with a low voice signal (poor signal-to-noise ratio) or by a mechanical or electrical failure of the CVR system that severely distorts or obscures the audio information.
- Unusable** Crew conversations may be discerned, but neither ordinary nor extraordinary means made it possible to develop a meaningful transcript of the conversations. This type of recording is usually caused by an almost total mechanical or electrical failure of the CVR system.

APPENDIX B. CVR TRANSCRIPT

The following is a transcript of a Universal CVR-120 CVR, serial number unknown, installed on a Clay Lacy Aviation, Inc. HAWKER BEECHCRAFT CORP HAWKER 900XP involved in an accident on February 7, 2024 in Westwater, UT.

LEGEND

CAM	Cockpit area microphone voice or sound source
HOT	Flight crew audio panel voice or sound source
RDO	Radio transmissions from N900VA
CTR	Radio transmission from Denver center controller
DEP	Radio transmission from the Denver approach controller
GND	Radio transmission from the Grand Junction (GJT) ground controller
TWR	Radio transmission from the Grand Junction (GJT) airport tower controller
-1	Voice identified as the PIC
-2	Voice identified as the SIC
-?	Voice unidentified
*	Unintelligible word
#	Expletive
@	Non-pertinent word
()	Questionable insertion
[]	Editorial insertion

Note 1: Times are expressed in Mountain Standard Time.

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

Note 3: Words shown with excess vowels, letters, or drawn-out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control, or condition of the aircraft.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
1015:38.7	START OF RECORDING		
	START OF TRANSCRIPT		
10:16:36.8			
CAM	[sounds and discussion consistent with initial checks and setting up for the departure].		
10:17:34.8			
CAM	[sound similar to stick shaker].		
10:22:18.3			
CAM	[sounds and discussion consistent with performance of the before start checklist].		
10:25:36.2			
CAM	[sounds and discussion consistent with closing of the cabin door].		
10:27:13.4			
CAM	[sounds and discussion consistent with performance of the start checklist].		
10:29:47.9			
CAM	[sounds and discussion consistent with performance of the after start checklist].		
10:30:37.8			
CAM	[sounds and discussion consistent with performance of the before takeoff checklist].		
10:31:37.0			
HOT	[sounds consistent with engine computer and engine anti-ice checks].		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:31:37.9 HOT-1	yeah we'll do the, anti-ice, we'll do all that stuff on this one.		
10:31:42.9 CAM	[sound of engine spooling up and down].		
10:31:49.9 CAM	[sound of engine spooling up and down].		
10:32:56.3 HOT-2	alright what are we at Western?		
10:32:57.7 HOT-1	we're West Star North.		
		10:33:00.2 RDO-2	good morning ground you got hawker nine hundred victor alpha Western North taxi india.
		10:33:07.5 GND	hawker nine hundred victor alpha * * runway one one taxi alpha.
		10:33:12.4 RDO-2	one one via alpha nine hundred victor alpha.
10:33:15.2 HOT-1	alrighty.		
10:33:15.6 HOT-2	ehah left turn right turn via alpha.		
10:33:21.6 HOT-1	left turn left turn.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:33:23.3 HOT-2	yeah left.		
10:33:24.4 HOT-1	left turn left turn.		
10:33:25.0 HOT-2	yeah I got it.		
10:33:25.4 HOT-1	yup.		
10:33:28.5 HOT-2	alright.		
10:33:29.0 HOT-1	alright, before takeoff.		
10:33:33.4 HOT-2	clear right.		
10:33:35.1 HOT-2	brakes.		
10:33:36.3 HOT-1	checked.		
10:33:36.6 HOT-2	anti-ice.		
10:33:38.9 HOT-2	is tested. eh A-P-R tested. engine computers rudder bias T-R's checked. flaps, are verified fifteen for takeoff.		
10:33:46.5 HOT-1	fifteen.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:33:48.5 HOT-2	battery amps are checked below twenty ** and fuel verified at seven thousand F-M-S, F-M-S two, F-M-S one checked before takeoff items are complete lineup is next.		
10:34:00.4 HOT-1	rog...		
10:34:06.1 HOT-1	alrighty, briefing is ah fly heading til we hear otherwise going to Junction and then ah up to fourteen and hopefully we can just hold it at fourteen and do the ah maneuvers at fourteen.		
10:34:18.3 HOT-2	right.		
10:34:22.2 HOT-2	and ahm we got that right turn to heading of ah one five zero.		
10:34:26.4 HOT-1	ayefirm...		
10:34:30.4 HOT-2	***.		
10:34:56.0 HOT-1	wonder if that thing still flies that jetstream it appears that it does.		
10:35:02.1 HOT-1	any time in a jetstream?		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:35:05.1 HOT-2	jetstream forty one.		
10:35:06.7 HOT-2	not the ah thirty two, but the * one that was my first airline job with Trans World Express * all first class * cockpit too.		
10:35:08.0 HOT-1	ah.		
10:35:11.2 HOT-1	alright.		
10:35:14.3 HOT-1	oof.		
10:35:15.5 HOT-2	Garrett engines, flight attendant, whole nine yards.		
10:35:16.4 HOT-1	now * oohhh.		
10:35:23.3 HOT-2	yeah the thirty two's they had were 'er thirty one's and thirty two's were all all no autopilots.		
10:35:27.9 HOT-1	# yeah.		
10:35:31.6 HOT-1	I felt bad for a lo- I mean they learned to fly, pretty well but ah I felt bad for 'em * having to just hand fly for... hours on end five or six legs a day.		
10:35:41.2 HOT-2	on tower. departure one one niner point seven.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:35:43.4 HOT-1	thank ya.		
		10:35:53.6 RDO-2	morning tower hawker nine hundred victor alpha ready at the end.
		10:35:57.2 TWR	hawker nine hundred victor alpha Grand Junction tower hold short runway * one awaiting (for) release.
		10:36:01.3 RDO-2	holding short one one hawker nine hundred victor alpha.
		10:36:18.7 TWR	hawker zero victor alpha runway one one cleared for takeoff.
		10:36:21.3 RDO-2	one one cleared for takeoff hawker nine hundred victor alpha.
10:36:23.7 HOT-?	clear right.		
10:36:24.2 HOT-?	clear left.		
10:36:25.2 HOT-1	clear right and left.		
10:36:26.0 HOT-2	*.		
10:36:26.9 HOT-1	lineup checks.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:36:27.1 EGPWS	approaching one one.		
10:36:28.5 HOT-2	exterior lights.		
10:36:29.2 HOT-2	checks.		
10:36:30.2 HOT-1	all on.		
10:36:30.8 HOT-2	transponder?		
10:36:32.1 HOT-?	*.		
10:36:32.9 HOT-1	T-A-R-A yup.		
10:36:34.1 HOT-2	TCAS?		
10:36:36.4 HOT-1	that's you.		
10:36:37.3 HOT-2	and flight controls.		
10:36:38.6 HOT-1	bottoms are good.		
10:36:39.4 HOT-2	checkin' the top.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:36:40.9 HOT-2	anti-ice is off. M-W-S check FARTS.		
10:36:44.5 HOT-1	flaps fifteen. airbrakes are shut. runway is correct. speeds and trims are all one and two and three and cleared for takeoff.		
10:36:54.1 EGPWS	on runway one one.		
10:36:55.8 HOT-2	runway one one confirmed?		
10:36:57.0 CAM	[sound of increased engine noise].		
10:36:57.1 HOT-1	affirm.		
10:36:59.1 HOT-1	here we go.		
10:37:00.0 HOT-2	my tops.		
10:37:02.0 HOT-2	A-P-R's armed.		
10:37:06.3 HOT-2	clock is started.		
10:37:12.4 HOT-2	eighty knots crosschecked.		
10:37:14.1 HOT-1	I got the tops.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:37:14.9 HOT-2	your tops.		
10:37:18.0 HOT-2	V1.		
10:37:20.0 HOT-2	rotate.		
10:37:24.2 HOT-2	V2.		
10:37:25.4 HOT-2	positive rate.		
10:37:26.2 HOT-1	gear up.		
10:37:27.1 HOT-2	landing gear selected up.		
10:37:35.9 HOT-1	flaps up.		
10:37:36.1 HOT-2	four hundred.		
10:37:38.2 HOT-2	flaps selected zero. right turn one five zero that's heading mode.		
10:37:44.3 HOT-1	oops put in heading please.		
10:37:46.5 HOT-2	selected.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:37:47.3 HOT-1	thank you much.		
10:37:48.0 HOT-2	flaps are up A-P-R air valves are open.		
10:37:51.0 HOT-1	yaw dampener on.		
10:37:52.0 HOT-2	and yaw damper coming on. it is on.		
10:37:56.4 HOT-1	and autopilot. what the #. let's go crazy.		
10:37:57.8 HOT-2	autopilot engaged.		
10:38:05.5 HOT-2	APU's comin' off. stop button.		
10:38:07.7 HOT-1	yup.		
		10:38:09.6 TWR	hawker zero victor alpha heading one five zero contact departure.
		10:38:12.4 RDO-2	departure on heading one five zero we'll see ya.
		10:38:21.2 RDO-2	good morning departure you got hawker nine hundred victor alpha heading one five zero. seven point four to one four thousand.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
		10:38:26.7 DEP	* nine hundred victor alpha denver departure radar contact turn right and proceed direct to the Junction V-O-R.
		10:38:31.6 RDO-2	right turn direct to Junction V-O-R Hawker nine hundred victor alpha.
10:38:37.7 HOT-2	agreed.		
10:38:38.8 HOT-1	execute.		
		10:38:40.1 DEP	hawker nine hundred victor alpha you're looking to do some air work once you get on center's frequency?
		10:38:44.8 RDO-2	yes that's correct for you know in the mid teens for about ten minutes.
		10:38:51.2 DEP	(november) nine hundred victor alpha roger there is some light precip in vicinity of the Junction V-O-R about (one zero) miles in diameter so far it's just showin' light.
		10:38:58.2 RDO-2	[sound similar to microphone double click].
10:38:59.8 HOT-2	roger that * * *.		
10:39:06.2 HOT-2	landing gear's up. main air valves are open. flaps are up. yaw damper's on. thrust reverser A-P-R is off. engine sync if you want that.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:39:12.8 HOT-2	there is (a bird).		
10:39:14.0 HOT-1	yuppers.		
10:39:15.4 HOT-2	N1?		
10:39:16.6 HOT-1	ah yup.		
10:39:17.2 HOT-2	N1 goes on. the anti-ice is off. APU. that is shut down.		
10:39:23.7 HOT-2	after takeoff checklist is completed.		
10:39:30.6 HOT-2	and we can go landing lights (off).		
		10:39:32.8 DEP	* nine hundred victor alpha climb maintain flight level two six zero.
		10:39:35.2 RDO-2	flight level two six zero hawker nine hundred victor alpha.
		10:39:37.8 DEP	hawker nine hundred victor alpha if you wanted something below that just talk to Denver center you can contact them now one three four point five have a great day.
		10:39:44.4 RDO-2	(fifty) four point five we'll see ya.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:39:52.8 HOT-2	what altitude to whatever some- * *.		
10:39:54.3 HOT-1	yeah let's just yeah climbin' to two si- tell 'em we'll we'll request a ah altitude once we get above in V-M-C.		
		10:40:01.6 RDO-2	and good morning Denver you got hawkers nine hundred victor alpha climbing twelve thousand to two six zero.
		10:40:12.2 CTR	niner victor alpha Denver center ah say that again please?
		10:40:15.6 RDO-2	yeah we're off ah Grand Junction climbing twelve point five to ah two six zero.
		10:40:21.6 CTR	* niner hundred victor alpha roger and do you need to stop somewhere along the climb to do some airwork or do you need to just climb all the way up?
		10:40:27.5 RDO-2	yeah that is correct * once we get on top here we'd like to stop for about ten minutes to do some checks.
		10:40:32.9 CTR	nine hundred victor alpha roger just let me know what altitude you wanna stop at and we'll assign it.
		10:40:37.0 RDO-2	copy we'll let you know ah nine hundred victor alpha.
10:40:42.0 HOT-2	ah lights are off okay checklist is done.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:40:49.3 HOT-2	alright, cooking with gas (capt'n).		
10:40:50.7 HOT-1	yeah baby.		
10:41:11.7 HOT-2	no surging engines. nothing. I don't see any issues.		
10:41:16.3 HOT-1	nope.		
10:41:19.4 HOT-1	take a turn up there.		
10:41:54.5 HOT-1	[sound of sigh].		
10:42:04.5 HOT-2	most importantly does the WiFi work.		
10:42:06.3 HOT-1	yup.		
10:42:07.8 HOT-2	[sound of chuckle].		
10:42:10.4 HOT-1	ask 'em if we can get a block from one eight oh to two zero zero if we can't do that then, yeah just see if we can do that.		
		10:42:20.9 RDO-2	and hawker nine hundred victor alpha with request.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
		10:42:23.8 CTR	hawker nine hundred victor alpha go ahead.
		10:42:25.3 RDO-2	yeah looking for a block altitude of eighteen thousand to two zero zero.
		10:42:28.6 CTR	alright niner victor alpha maintain block from flight level one eight zero to flight level two zero zero.
		10:42:32.5 RDO-2	block eighteen to two zero zero thank you sir nine hundred victor alpha.
10:42:35.0 HOT-1	two zero zero please.		
10:42:39.4 HOT-1	I see it.		
10:42:39.5 HOT-2	set.		
10:42:52.1 HOT-2	so we're gonna log 'em down here, right?		
10:42:52.2 HOT-1	alright yeah so we're gonna do 'em clean.		
10:42:56.0 HOT-1	alright, set standard.		
10:42:59.6 HOT-1	climb check.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:43:08.8 HOT-2	climb checklist complete.		
10:43:15.1 HOT-2	alright so we got ahhh flaps zero target and I'm just gonna log you're numbers here, here, here, here.		
10:43:16.8 HOT	[sound similar to altitude alert warning tone].		
10:43:18.7 HOT-1	yeah.		
10:43:22.6 HOT-2	nineteen for twenty.		
10:43:27.7 HOT-1	and if you can grab his attention and say if he needs a heading to keep in his airspace, we can take any heading he wants.		
10:43:35.1 HOT-2	okay.		
10:43:43.5 HOT-1	my ears.		
10:43:45.1 HOT-1	do those, are we, are we in normal?		
10:43:47.7 HOT-2	are we in what?		
10:43:48.2 HOT-1	are we in normal under the ah underneath there?		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:43:51.4 HOT-2	yes.		
10:43:51.9 HOT-1	okay.		
10:43:53.4 CAM	[sound of engine noise decreasing].		
		10:44:08.8 RDO-2	and for hawker nine hundred victor alpha if you need to turn us left or right to stay in your airspace that's fine.
		10:44:14.1 CTR	nine hundred victor alpha you can maneuver as necessary ah do you how long do you do this ah airwork for?
10:44:19.7 HOT-1	ten minutes tops.		
		10:44:20.2 RDO-2	just about ten minutes or less.
		10:44:23.3 CTR	yeah ah just continue on your route of flight or ah at least that direction you're cleared to navigate right and left ah when you're able proceed direct Wasatch and advise.
		10:44:31.8 RDO-2	okay when we're ready we'll go to Wasatch and advise nine hundred victor alpha.
10:44:40.3 HOT-2	alright.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:44:41.2 HOT-1	alright here we go my friend.		
10:44:42.8 HOT-2	so we're taking indicated's, right?		
10:44:44.4 HOT-1	ah yeah, indicated, we're lookin' for shaker, pusher, I'll call mark on pusher if you can't, see it for, some reason.		
10:44:53.3 HOT-2	okay.		
10:44:55.3 HOT-2	'kay.		
10:44:59.8 CAM	[sound similar to autopilot disconnect warning].		
10:45:02.0 HOT-2	good # man, what are they doing?		
10:45:29.8 HOT-1	are we havin' fun yet?		
10:45:32.0 HOT-2	slowly.		
10:45:42.6 HOT-1	why can't I do this in the sim? I'm all over the place in the sim [sound of chuckle].		
10:45:45.9 HOT-2	I know.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:45:50.9 CAM	[sound similar to gear warning horn].		
10:45:53.2 HOT-1	that's a beer.		
10:46:33.1 CAM	[sound similar to stick shaker].		
10:46:33.9 HOT-2	one nineteen.		
10:46:35.2 HOT-2	**.		
10:46:36.7 HOT-1	ooh # #.		
10:46:37.0 CAM	[sound of rattling and stick shaker sound].		
10:46:38.5 CAM	[sound of increasing engine noise].		
10:46:38.9 CAM	[sound of rattling and stick shaker sound].		
10:46:38.9 EGPWS	bank angle, bank angle.		
10:46:39.4 HOT-1	#. ahh # me.		
10:46:40.7 CAM	[sound of rattling and stick shaker sound].		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:46:42.0 EGPWS	bank angle, bank angle.		
10:46:42.2 CAM	[sound similar to altitude alert warning tone].		
10:46:42.4 CAM	[sound similar to gear warning horn].		
10:46:42.7 CAM	[sound of rattling and stick shaker sound].		
10:46:45.9 HOT-1	oh # # # # oh my # ohhh.		
10:46:47.4 EGPWS	bank angle.		
10:46:56.3 HOT-2	# me.		
10:46:56.5 CAM	[sound similar to gear warning horn].		
10:46:59.9 HOT-?	*.		
10:47:02.0 HOT-2	[sound of heavy breathing].		
10:47:02.1 HOT-1	I can't hold it, I can't # hold it.		
10:47:07.4 HOT-1	I can't hold it.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:47:11.5 HOT-2	what are you off the rudder?		
10:47:13.4 HOT-1	yeah.		
10:47:14.1 HOT-2	you got nose down? you got sp- speed?		
10:47:14.8 HOT-1	I got *.		
10:47:16.9 HOT-1	[sound of panting].		
10:47:20.1 CAM	[sound similar to gear warning horn].		
10:47:23.5 HOT-2	speedbrakes in or out?		
10:47:24.0 CAM	[sound similar to gear warning horn].		
10:47:26.9 HOT-2	dive it or something # #.		
10:47:31.5 HOT-1	#.		
10:47:33.4 EGPWS	twenty five hundred.		
10:47:34.3 HOT-2	(opposite).		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
10:47:35.0 HOT-1	ahhh I can't I can't I can't.		
10:47:36.7 HOT-2	forward. put it forward. put it forward.		
10:47:39.1 EGPWS	terrain, terrain, pull up, pull up, up.		
10:47:40.4 HOT-1	oh #.		
10:47:41.6 HOT-2	we're dead.		
10:47:44.0 END OF TRANSCRIPT END OF RECORDING			